We claim:

1. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a core reaction zone, the core reaction zone being configured to conduct exothermic reactions including at least one of combustion, partial oxidation, autothermal reforming, water gas shift, preferential oxidation and combinations thereof;

shells each having a shell wall, the shells being arranged coaxially about the core reaction zone;

a gap being defined between each of the shells' walls to form a plurality of coaxial zones, the reactor being configured to permit heat transfer directly from one zone to another; and

the reactor being configured so that hydrocarbon feed stock is preheated from about its storage temperature substantially to its desired preheat temperature by traversing a first zone, and an oxygen containing gas is preheated from about its storage temperature substantially to its desired preheat temperature by traversing a second zone.

2. The reactor of claim 1 including that the reactor being further configured so that water/steam is preheated in a third zone.

3. The reactor of claim 1 including that the reactor being further configured so that water/steam is preheated along with the feedstock in the first zone.

4. The reactor of claim 2 including that the reactor being further configured so that reaction gases from one or more of the exothermic reactions is flowed through a fourth zone for heat transfer with at least one of the first, second or third zones.

5. The reactor of claim 1 including a burner to supply heat to a steam reforming reaction in the core reaction zone.

6. The reactor of claim 5 including that the reactor being further configured so that at least a portion of the oxygen containing gas from the second zone is used to supply the burner.

7. The reactor of claims 1 including that the reactor being further configured so that the oxygen containing gas from the second zone is used to supply a partial oxidation reaction in the core reaction zone.

8. The reactor of claim 5 including that the reactor being further configured so that oxygen containing gas to support burner combustion is preheated in a zone.

9. The reactor of claims 4 including that the reactor being further configured having a burner and wherein exhaust from the burner is flowed through a zone for heat exchange with one or more other zones.

10. The reactor of claim 8 including that the reactor being further configured so that exhaust from the burner is flowed through a zone for heat exchange with one or more other zones.

11. The reactor of claim 4 including that the reactor being further configure so that zone one includes a hydrocarbon feedstock and water/steam traveling in a countercurrent direction to a material flow through the core reaction zone;

the stream of zone two travels in a direction countercurrent to flow through the core reaction zone; and

the stream of zone four travels in a direction concurrent to the direction of flow through the core reaction zone.

12. The reactor of claim 11 including that the reactor being further configured so that the zones are arranged in order outwardly from the core reaction zone, one, four, and then two.

13. The reactor of claims 4 including that the reactor being further configured so that flow through zone four is concurrent with a material flow through the core reaction zone; and

material flow through all other zones is countercurrent to the flow of material through the core reaction zone.

14. The reactor of claim 13 including that the reactor being further configured so that the zones are arranged in order traveling radially outward from the core reaction zone, one, four, two, five, and optionally six.

15. The reactor of claim 13 including that the reactor being further configured so that the zones are arranged in order traveling radially outward from the core reaction zone, one, four, three, two, five, and optionally six.

16. The reactor of claim 1 including that the reactor being further configured so that the zones have gaps such that flow is predominantly turbulent in each zone.

17. The reactor of claim 1 including spacers placed in the zones to maintain spacing between successive shells.

18. The reactor of claim 17, wherein spacers are selected from the group including dimples, rods, or flat or undulating screens.

19. The reactor of claim 1 including a steam reformer in the core reaction zone.

20. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a core reaction zone, the core reaction zone being configured to conduct exothermic reactions including at least one of combustion, partial oxidation, water gas shift, autothermal reforming, selective oxidation, and combinations thereof;

a steam reformer in the core reaction zone;

a burner;

shells arranged coaxially about the core reaction zone and a gap being defined between each of the successive shells to form a plurality of coaxial zones, the shells being configured to permit heat transfer directly from one zone to one or more adjacent zone; and

the reactor being configured so that a hydrocarbon fuel is flowed through a first zone, an oxygen containing gas for partial oxidation is flowed through a second zone, water/steam is flowed through a third zone, exhaust from the burner is flowed through a fourth zone, an oxygen containing gas for combustion in the burner is flowed through a fifth zone, and a burner fuel is flowed through a sixth zone.

21. A method of reforming hydrocarbons to provide a hydrogen rich gas comprising the steps of:

generating heat by performing at least one of combustion, partial oxidation, water gas shift, autothermal reforming and selective oxidation;

transferring generated heat through walls of shells in a plurality of nested shells having a gap being defined between each of the successive shells to form a plurality of coaxial zones;

preheating a stream of hydrocarbon feed stock in a first zone;

preheating a stream of steam in a second zone;

preheating a stream of oxygen containing gas in a third zone; and

introducing the hydrocarbon feed stock and steam to a reforming zone which may be in one of the coaxial zones or in a core reaction zone located within the innermost shell.

22. The method of claim 21, wherein the hydrocarbon feed stock stream and the steam stream are a single mixed stream.

23. The method of claim 21, further comprising routing a heated stream through a zone annularly disposed about the central zone and transferring heat from the heated stream to material in another zone.

24. The method of claim 21, further comprising routing a stream of reformate through a zone annularly disposed about the central zone and preheating anode exhaust from a fuel cell in a zone annularly disposed about the central zone using the stream of reformate.

25. A reactor for generating a hydrogen-enriched reformate from hydrocarbon feed stocks comprising:

shells having walls arranged coaxially about each other;

a gap being defined between each of the successive shells forming a plurality of coaxial zones, the shells being configured to permit heat transfer directly from one zone to another;

wherein a first zone is configured to conduct steam reforming and at least one of the exothermic reactions from the group including combustion, partial oxidation, autothermal reforming, water gas shift, preferential oxidation, and combinations thereof; and

the reactor being configured so that hydrocarbon feed stock is preheated in a second zone and an oxygen containing gas is preheated in a third zone.

26. The reactor of claim 25 including that the reactor being further configured so water/steam is preheated in a fourth zone.

27. The reactor of claim 26 including that the reactor being further configured so that water/steam is preheated along with the hydrocarbon feed stock in the second zone.

28. The reactor of claim 27 further comprising a burner.

29. The reactor of claim 28 including that the reactor being further configured to preheat a stream of burner fuel in a zone.

30. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a core reaction zone, the core reaction zone being configured to conduct steam reforming;

shells arranged coaxially about the core reaction zone and a gap being defined between each of the successive shells to form a plurality of coaxial zones, the shells being configured to permit heat transfer from one zone to another;

a burner which is configured to generate a heated exhaust gas stream;

the reactor being configured so that hydrocarbon feed stock is preheated in a first zone, an oxygen containing gas is preheated in a second zone; and

wherein the burner generated heated exhaust gas stream is routed through a third zone disposed between the first and second zones, and is used to preheat the first and second zones through heat transfer through shared walls.

31. The reactor of claim 30 wherein material flow through the first and second zones is concurrent with one another, and wherein material flow through the third zone is countercurrent to these flows.

32. The reactor of claim 30 wherein a burner fuel is at least partially anode gas from a fuel cell.

33. A method for reforming hydrocarbons to produce a hydrogen rich reformate comprising:

routing a first reforming reactant stream through a first gap coaxially disposed about a first shell having a wall and defining a core reaction zone containing a steam reformer;

wherein the temperature within the core reaction zone is higher than the temperature of the first reforming reactant flowing through the first gap;

flowing the first reforming reactant through the first gap and to the core reaction zone; and

reforming a hydrocarbon feedstock within the core reaction zone.

34. The method of claim 33 wherein the first reforming reactant includes a hydrocarbon.

35. The method of claim 33 further comprising feeding an oxygen containing gas to the core reaction zone.

36. The method of claim 33 further comprising autothermally reforming the hydrocarbon feedstock.

37. A reactor for reforming hydrocarbons to produce a hydrogen rich reformate comprising:

a plurality of nested shells each having an annular wall and having a gap between each adjacent wall defining a zone;

the reactor being configured such that each zone contains a different heat transfer medium and wherein the heat transfer mediums travel through the zones and exchange heat through shell walls.

38. The reactor of claim 37 wherein each heat transfer medium passes through only one zone before being either reacted or discharged from the reactor.

39. The reactor of claim 37 further comprising a plurality of at least five nested shells.

40. A reactor for the reforming of hydrocarbons into a hydrogen rich product comprising:

a plurality of nested shells having a gap defined between each of the successive shells to form a plurality of coaxial zones between adjacent shells;

a stream of heated material produced by an exothermic reaction including at least one of combustion, partial oxidation, autothermal reforming, water gas shift, preferential oxidation, and combinations thereof;

a second stream of heated material produced by an exothermic reaction including at least one of combustion, partial oxidation, autothermal reforming, water gas shift, and preferential oxidation; and

wherein the streams of heated materials are each routed through zones adjacent to at least one zone through which at least one of materials chosen from the group which includes hydrocarbon feedstock, steam, oxygen containing gas, and anode gas from a fuel cell are routed.

41. The reactor of claim 40 further comprising a reactor configured so the streams of heated material flow concurrently to each other, and countercurrent to the material flow in all other zones.

42. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a plurality of nested shells having walls arranged about a first innermost shell defining a zone, and a gap being defined between each of the successive shells forming a plurality of coaxial zones, the shells being configured to permit heat transfer from one zone to another; and

an end cap having multiple channels defined by stacked plates wherein the number of zones and plates are equal.

43. The reactor of claim 42 including that the reactor being further configured so that materials are inlet and outlet to and from the channels through the plates.

44. The reactor of claim 42 including that the reactor being further configured so that materials are routed between zones through the end cap.

45. The reactor of claim 42 including that the reactor being further configured so that hydrocarbon feedstock is preheated in a zone and an oxygen containing gas is preheated in a second zone.

46. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a core reaction zone, the core reaction zone being configured to conduct exothermic reactions including at least one of combustion, partial oxidation, autothermal reforming, water gas shift, preferential oxidation, and combinations thereof;

shells arranged coaxially about the core reaction zone and a gap being defined between each of the successive shells to form a plurality of coaxial zones, the shells being configured to permit heat transfer from one zone to another;

an end cap through which materials are inlet and outlet from the reactor, and in which material is routed between zones.

47. The reactor of claim 46 including that the reactor being further configured so that materials are inlet and outlet to and from the channels through the plates.

48. The reactor of claim 46 including that the reactor being further configured so that materials are routed between zones through the end cap.

49. A reactor for generating a hydrogen-enriched reformate from hydrocarbons comprising:

a plurality of nested shells having walls arranged coaxially and defining a gap between each of the successive shells forming a plurality of coaxial zones, the shells being configured to permit heat transfer from one zone to another; and

wherein a first zone contains a catalyst selected from the group including a steam reforming catalyst and a shift catalyst; and

the reactor being configured so that a hydrocarbon feed stock is preheated in a second zone, and an oxygen containing gas is preheated in a third zone.